New Prenylated Flavones from the Roots of *Ficus beecheyana*

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Two new prenylated flavanones, ficubee A and ficubee B, respectively, as 7,8-(2,2-dimethylpyrano)-6-prenyl-5,3′,4′-trihydroxyflavone and 6,7-(2,2-dimethylpyrano)-8-prenyl-5,3′,4′-trihydroxyflavone were isolated from the roots of *Ficus beecheyana* together with twelve known compounds: β-sitosterol, 5-stigmasten-3β,7α-diol, 5-stigmasten-3β,7β-diol, 3β-hydroxystigmast-5-en-7-one, 4-hydroxybenzaldehyde, 4-hydroxy-3-methoxybenzaldehyde, 1-(4-hydroxyphenyl)-ethanone, 4-hydroxy-3-methoxybenzoic acid, 4-hydroxycinnamic acid, seseline, xanthyletin, and psoralene. The structures of these secondary metabolites were determined by spectroscopic means and in comparison with published data.

Keywords: *Ficus beecheyana* Hook. & Arn.; Moraceae; Prenylated flavone; 7,8-(2,2-dimethylpyrano)-6-prenyl-5,3′,4′-trihydroxyflavone (ficubee A); 6,7-(2,2-dimethylpyrano)-8-prenyl-5,3′,4′-trihydroxyflavone (ficubee B).

INTRODUCTION

Ficus beecheyana Hook. & Arn. (Moraceae) is a semi-deciduous tree distributed in mainland China, Vietnam and Taiwan.[1] Its rhizomes have been used as a folk medicine to treat rheumatism and diabetes.[2] We recently reported the isolation of six phenolics from the roots of *F. beecheyana*.[3] Their structures were established as threo and *erythro*-2,3-*bis*(4-hydroxy-3-methoxyphenyl)-3-ethoxypropan-1-ol, *trans*-4,5-bis(4-hydroxy-3-methoxyphenyl)-1,3-dioxacyclohexane, *threo*-3-(4-hydroxy-3-5-dimethoxyphenyl)-3-ethoxypropane-1,2-diol, 2-3-dihyolroxy-1-(4-hydroxy-3,5-dimethoxyphenyl)-1-propanone, and 3-hydroxy-1-(4-hydroxy-3,5-dimethoxyphenyl)-1-propanine. Further studies on the same plant have now led to the isolation of the known β-sitosterol (**1**), 5-stigmasten-3β,7α-diol (**2**), 5-stigmasten-3β,7β-diol (**3**), 3β-hydroxystigmast-5-en-7-one (**4**), 4-hydroxybenzaldehyde (**5**), 4-hydroxy-3-methoxybenzaldehyde (**6**), 1-(4-hydroxyphenyl)-ethanone (**7**), 4-hydroxy-3-methoxybenzoic acid (**8**), 4-hydroxycinnamic acid (**9**), seseline (**10**), xanthyletin (**11**), and psoralene (**12**), and two new prenylated flavones for which the names ficubee A (**13**) and B (**14**) are proposed. This paper deals with the isolation and characterization of the two new prenylated flavones.

RESULTS AND DISCUSSION

Compounds **13** and **14** were found to be difficult to obtain in pure form. Normal phase HPLC analysis of the mixture part did not give any separation and with only one peak appearing in each chromatogram. Therefore, the structural determinations of **13** and **14** were based mainly on their acetate derivatives with pyridine-acetic anhydride which afforded the triacetate ficubee A (**13a**) and ficubee B (**14a**).

Compound **13a** was obtained as powder. The EIMS showed a molecular ion at *m/z* 546, and the molecular formula $C_{31}H_{30}O_9$ was deduced from this together with its NMR and DEPT data. The signal in the ^{1}H NMR spectrum observed at δ 6.51 is assigned to the C-3 proton of a flavone. This skeleton was supported by its UV spectrum. The ^{1}H NMR spectrum of **13a** shows two groups: a singlet (6H) at δ 1.52 and two doublets (1H) at δ 5.71 and 6.81 (J =10 Hz); and two methyl signals (δ 1.65, 1.76) and a methene proton (δ 3.26), suggesting the presence of 2,2-dimethylpyran and γ,γ-dimethylallyl (= prenyl) moiety, respectively. Furthermore, a typical ABX system at δ 7.33 (d, J = 8.4 Hz), 7.63 (d, J = 2.0 Hz) and 7.69 (dd, J = 8.4, 2.0 Hz) showed the presence of three aromatic protons. The ^{13}C NMR spectrum of **13a** showed five oxygenated aromatic carbon signals, two of which were

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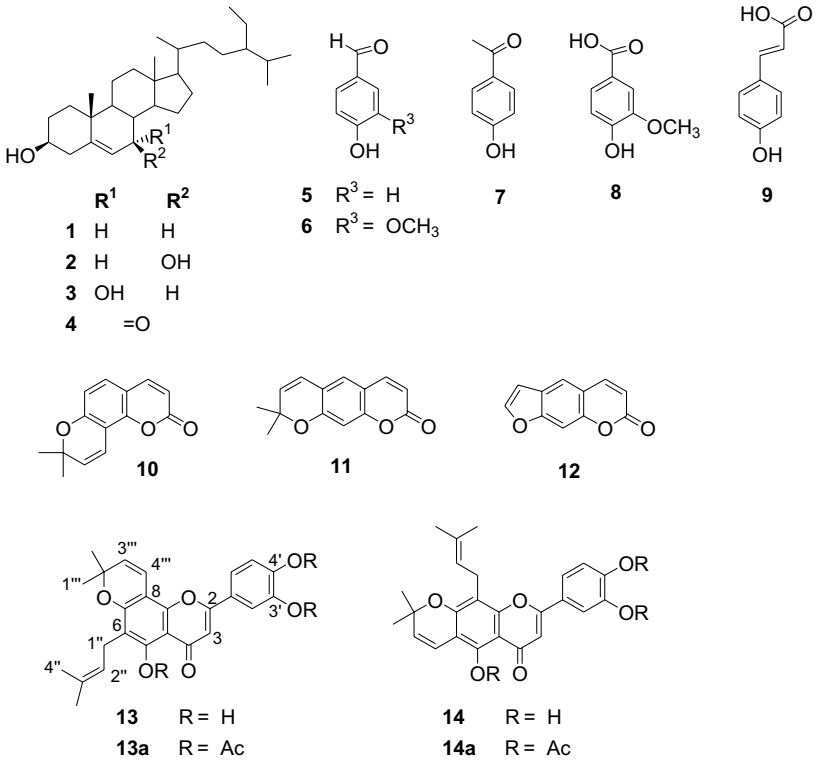

assigned to the *ortho* diacetoxy carbons (δ 144.2 (s) and 144.5 (s)); the remaining three are *meta* oriented in a substituted benzene ring and their chemical shifts at δ 147.0 (s), 151.3 (s) and 155.7 (s) are consistent with the structure shown for **13a**. The prenyl and 2,2-dimethylpyran groups are located in ring A. Two possibilities were considered regarding the position of the prenyl group: one with a linear pyran and a prenyl group at C-8 or an alternative structure with an angular pyran ring and the prenyl substituent at C-6.

Confirmation of the location of the pyran group at position 8 was obtained from HMBC data (Fig. 1), which showed correlations of H-3′″ (δ 5.71) with C-8 (δ 107.4), H-1″ (δ 3.26) with C-7 (δ 155.7) and C-5 (δ 147.0). From the above spectroscopic data, the structure of ficubee A (**13**) was deduced to be 7,8-(2,2-dimethylpyrano)-6-prenyl-5,3′,4′-trihydroxyflavone.

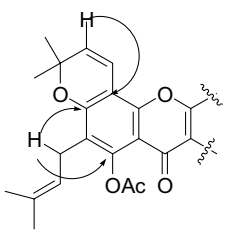

Fig. 1. Major HMBC correlations of **13a**.

Compound **14a** was obtained in a very small amount. Its molecular formula was assumed to be $C_{31}H_{30}O_9$ on the basis of HR-EIMS data. Like compound **13a**, the NMR spectra showed resonance signals for one prenyl group, a 2,2-dimethylpyrane ring, and two aromatic carbons bearing *ortho* oxygenated substituents. The same molecular mass and the similarity of their NMR spectra (Table 1) of **13a** and **14a** led us to believe that they were isomers. The ^{1}H NMR spectrum of **14a**, the signal of H-4′″ at δ 6.48 (d, J = 10.1 Hz) is shifted to the up field (0.33 ppm) compared with that in **13a**. On the other hand, the chemical shift of H-2″ of **14a** and **13a** exhibits an opposite shift. Therefore, we suggested the (6→7[O]) cyclization to give a linear 2,2-dimethylpyrane ring with the attachment of the other prenyl group at C-8. This result provides additional proof that the γ,γ-dimethylallyl side-chain is located at C-6 for ficubee A (**13a**) and at C-8 for ficubee B (**14a**).[4] The structure of ficubee B was determined to be 6,7-(2,2-dimethylpyrano)-8-prenyl-5,3′,4′-trihydroxyflavone. The new compounds, Ficubee A (**13**) and B (**14**) are regioisomers.

The known compounds obtained were identified as β-sitosterol (**1**),[5] 5-stigmasten-3β,7α-diol (**2**),[6,7] 5-stigmasten-3β,7β-diol,[7] 3β-hydroxystigmast-5-en-7-one (**4**),[8] 4-hydroxybenzaldehyde (**5**),[9] 4-hydroxy-3-methoxybenzaldehyde (**6**),[10] 1-(4-hydroxyphenyl)-ethanone (**7**),[11] 4-hydroxy-3-

Table 1. ^{1}H and ^{13}C-NMR Spectral Data for **13a** and **14a**

	13a		**14a**
No.	H	C	H
2		159.6	
3	6.51 (s)	108.9	6.51 (s)
4		176.5	
4a		110.5	
5		147.0	
6		132.0	
7		155.7	
8		107.4	
8a		151.3	
1′		130.5	
2′	7.63 (d, 2.0)	121.3	7.63 (d, 2.0)
3′		142.6	
4′		144.5	
5′	7.33 (d, 8.4)	124.3	7.33 (d, 8.4)
6′	7.69 (dd, 8.4, 2.0)	124.3	7.70 (dd, 8.4, 2.0)
1″	3.26 (d, 7.0)	22.5	3.56 (d, 7.0)
2″	5.08 (d, 7.0)	121.2	5.20 (d, 7.0)
3″		132.0	
4″	1.76 (s)	17.9	1.80 (s)
5″	1.65 (s)	25.7	1.67 (s)
1‴	1.52 (s)	28.2	1.41 (s)
2‴		78.2	
3‴	5.71 (d, 10.1)	129.7	5.74 (d, 10.1)
4‴	6.81 (d, 10.1)	115.1	6.48 (d, 10.1)
2‴-CH_3	1.52 (s)	28.2	1.46 (s)

[a] Measured in 300 MHz for ^{1}H, and 75 MHz for ^{13}C, in $CDCl_3$.
[b] Coupling constants (*J*) in Hz are given in parentheses.

methoxybenzoic acid (**8**),[12] 4-hydroxycinnamic acid (**9**),[13] seseline (**10**),[14] xanthyletin (**11**),[15] and psoralene (**12**),[16] in comparison of their spectral data (IR, NMR and MS) with those found in the literature and with authentic samples.

EXPERIMENTAL SECTION

General Methods

Melting points were determined with a Yanagimoto (MP-300) micro melting point apparatus and are uncorrected. IR spectra were recorded on a Nicolet Magna-550 spectrophotometer. ^{1}H and ^{13}C spectra were run on a Bruker AM-300 spectrometer. 2D-NMR spectra were run on a Bruker DMX-500SB spectrometer. EIMS and HR-EIMS were obtained on a Finnigan TSQ-700 and a JEOL SX-102 spectrometer, respectively. Column chromatography was performed with Merck Kieselgel 60 (70-230 mesh) as the stationary phase. HPLC was accomplished on a Hitachi L-7000 liquid chromatograph using LiChrospher (Merck, 7 μm, 250 × 10 mm) as a column.

Plant Material

The roots of *F. beecheyana* were collected in Nankang in north Taiwan in June 1999, and were identified by Mr. Chii-Cheng Liao of the Department of Botany, National Taiwan University. Voucher specimens (No. 19990615) have been deposited at Taipei Medical University, Taipei, Taiwan.

Extraction and Isolation

The dried crude EtOH extract of the roots of *F. beecheyana* (12 kg) was a gift from Dr. An-Pang Lin, Jen-Ai Chinese Medical United Clinic, Taipei, Taiwan. The ethanolic extract (81 g) was suspended in H_2O (500 mL) and then partitioned sequentially using *n*-hexane, $CHCl_3$, and *n*-BuOH (500 mL × 3). The $CHCl_3$-soluble fraction was evaporated under a vacuum to give an oily residue (39 g), which was adsorbed with 55 g of SiO_2 and then chromatographed on a column packed with 250 g of SiO_2 by eluting with the gradients of hexane and EtOAc. Every 100 mL of eluent was collected as one fraction, and fractions were monitored by TLC. Appropriate fractions were combined: (i) the elution with gradients of *n*-hexane/EtOAc (20:1) giving compounds **10**; (ii) the elution with gradients of *n*-hexane/EtOAc (10:2) giving compounds **1**, **5**, **6**, **7**, **11**, **12**; (iii) the elution with gradients of *n*-hexane/EtOAc (10:3) giving compounds **4**; (iv) the elution with gradients of *n*-hexane/EtOAc (10:4) giving compounds **2**, **3**, **8**, **9**, **13**, **14**. Purification of each compound was carried out by HPLC. The weights of each compound are as follows: **1** (109 mg), **2** (4 mg), **3** (12 mg), **4** (15 mg), **5** (11 mg), **6** (12 mg), **7** (7 mg), **8** (5 mg), **9** (21 mg), **10** (18 mg), **11** (34 mg), **12** (66 mg), **13** + **14** (5 mg). The mixture of **13** and 1**4** was dissolved in pyridine (4 mL) and Ac_2O (5 mL) and left overnight at 47 °C. Then, the reaction mixture was poured into ice water (30 mL) and stirred for 1 h. The resultant suspension was extracted with ethyl acetate (30 mL × 2). The ethyl acetate layer was washed with 1 N HCl, 3% aqueous $NaHCO_3$, and then brine water, sequentially. The organic layer was purified on HPLC with *n*-hexane-EtOAc-acetone (55:45:5) as eluent to yield the pure peracetylated derivatives **13a** (4 mg) and **14a** (1 mg).

β-Sitosterol (1)

Colorless solid; IR ν_{max} cm^{-1}: 3420, 1637, 1190, 1050; EIMS *m/z* (rel. int.) (%) 414 (M^+, 100), 412 (100); ^{1}H NMR ($CDCl_3$) δ: 0.66 (3H, s), 0.79 (3H, d, *J* = 6.5 Hz), 0.81 (3H, d, *J* = 6.5 Hz), 0.82 (3H, t, *J* = 7.1 Hz), 0.90 (3H, d, *J* = 6.5 Hz), 0.99 (3H, s), 3.51 (1H, m), 5.33 (1H, d, *J* = 5.2 Hz).

5-Stigmasten-3β,7α-diol (2)

Colorless solid; IR ν_{max} cm^{-1}: 3396, 2952, 2885, 1460; EIMS *m/z* (rel. int.) (%) 430 (M^+, 5), 412 (100), 394 (34), 379 (7); ^1H NMR ($CDCl_3$) δ: 0.66 (3H, s), 0.79 (3H, d, *J* = 6.5 Hz), 0.81 (3H, d, *J* = 6.5 Hz), 0.82 (3H, t, *J* = 7.2 Hz), 0.92 (3H, d, *J* = 6.5 Hz), 0.97 (3H, s), 3.57 (1H, m), 3.83 (1H, t, *J* = 3.0 Hz), 5.57 (1H, br d, *J* = 4.4 Hz); ^{13}C NMR ($CDCl_3$) δ: 11.6 (q), 12.0 (q), 18.2 (q), 18.8 (q), 19.0 (q), 19.8 (q), 20.7 (t), 23.0 (t), 24.3 (t), 28.9 (t), 29.1 (d), 29.2 (t), 31.3 (t), 33.9 (t), 36.1 (d), 37.0 (t), 37.3 (s), 37.5 (d), 39.1 (t), 42.0 (t), 42.1 (d), 42.2 (s), 45.8 (d), 49.4 (d), 55.7 (d), 65.4 (d), 71.4 (d), 123.8 (d), 146.3 (s).

5-Stigmasten-3β,7β-diol (3)

Colorless solid; EIMS *m/z* (rel. int.) (%) 430 (M^+, 4), 412 (100), 394 (26), 379 (15); ^1H NMR ($CDCl_3$) δ: 0.67 (3H, s), 0.79 (3H, d, *J* = 6.9 Hz), 0.81 (3H, d, *J* = 6.8 Hz), 0.83 (3H, t, *J* = 7.5 Hz), 0.90 (3H, d, *J* = 6.5 Hz), 1.02 (3H, s), 3.53 (1H, m), 3.82 (1H, br d, *J* = 7.9 Hz), 5.26 (1H, br s); ^{13}C NMR ($CDCl_3$) δ: 11.8 (q), 12.0 (q), 18.8 (q), 19.0 (q), 19.1 (q), 19.8 (q), 21.0 (t), 23.0 (t), 26.1 (t), 26.4 (t), 28.5 (t), 29.1 9d), 29.7 (t), 31.5 (t), 33.9 (t), 36.1 (d), 36.4 (s), 36.9 (t), 39.5 (t), 40.8 (d), 41.6 (t), 42.9 (s), 45.8 (d0, 48.2 (d), 55.3 (d), 55.9 (d), 71.4 (d), 7.3 (d), 125.4 (d), 143.5 (s).

3β-Hydroxystigmast-5-en-7-one (4)

Colorless solid; IR ν_{max} cm^{-1}: 3365, 1662, 1057; EIMS *m/z* (rel. int.) (%) 428 (M^+, 100), 410 (13), 385 (6), 382 (34); ^1H NMR ($CDCl_3$) δ: 0.65 (3H, s), 0.76 (3H, d, *J* = 6.5 Hz), 0.78 (3H, d, *J* = 6.5 Hz), 0.80 (3H, t, *J* = 7.2 Hz), 0.89 (3H, d, *J* = 6.3 Hz), 1.16 (3H, s), 3.64 (1H, m), 5.65 (1H, br s); ^{13}C NMR ($CDCl_3$) δ: 11.9 (q), 17.3 (q), 18.9 (q), 19.0 (q), 19.8 (q), 21.2 (t), 23.0 (t), 26.0 (t), 26.3 (t), 28.5 (t), 29.1 (d), 31.1(t), 31.5 (t), 33.9 (t), 36.0 (d), 36.3 (s), 38.3 (t), 38.6 (t), 41.8 (t), 43.1 (s), 45.4 (d), 45.8 (d), 49.9 (d), 55.3 (d), 54.6 (d), 70.4 (d), 125.9 (d), 165.5 (s), 202.5 (s).

4-Hydroxybenzaldehyde (5)

Colorless solid; mp 112-113 °C; EIMS *m/z* (rel. int.) (%) 428 (M^+, 100), 410 (13), 385 (6), 382 (34); ^1H NMR ($CDCl_3$) δ: 6.96 (2H, d, *J* = 8.6 Hz), 7.79 (2H, d, *J* = 8.6 Hz), 9.82 (1H, s).

4-Hydroxy-3-methoxybenzaldehyde (6)

Colorless solid; mp 83-85 °C; EIMS *m/z* (rel. int.) (%) 152 (M^+, 24), 151 (100), 137 (8); ^1H NMR ($CDCl_3$) δ: 3.92 (3H, s), 6.40 (1H, s, -OH), 7.06 (1H, d, *J* = 8.4 Hz), 7.38 (1H, br s), 7.40 (1H, br d, *J* = 8.4 Hz), 9.79 (1H, s); ^{13}C NMR ($CDCl_3$) δ: 56.1 (q), 108.8 (d), 114.4 (d), 127.6 (d), 129.8 (s), 147.2 (s), 151.8 (s), 191.1 (d).

1-(4-Hydroxyphenyl)-ethanone (7)

Colorless solid; mp 108-110 °C; IR ν_{max} cm^{-1}: 3300, 1662; EIMS *m/z* (rel. int.) (%) 136 (40), 121 (100); ^1H NMR ($CDCl_3$) δ: 2.53 (3H, s), 6.89 (2H, d, *J* = 8.4 Hz), 7.86 (2H, d, *J* = 8.4 Hz); ^{13}C NMR ($CDCl_3$) δ: 26.2 (q), 115.4 (d), 129.9 (s), 131.0 (d), 160.9 (s), 197.4 (s).

4-Hydroxy-3-methoxybenzoic acid (8)

Colorless solid; IR ν_{max} cm^{-1}: 3475, 3200-2500, 1676, 1596; EIMS *m/z* (rel. int.) (%) 168 (100), 153 (70), 125 (23); ^1H NMR (CD_3COCD_3) δ: 3.89 (3H, s), 6.90 (1H, d, *J* = 8.3 Hz), 7.56 (1H, d, *J* = 2.3 Hz), 7.58 (1H, dd, *J* = 8.3, 2.3 Hz); ^{13}C NMR (CD_3COCD_3) δ: 56.4 (q), 113.5 (d), 115.6 (d), 124.9 (d), 133.8 (s), 148.2 (s), 152.2 (s), 167.8 (s).

4-Hydroxycinnamic acid (9)

Colorless solid; EIMS *m/z* (rel. int.) (%) 136 (40), 121 (100); ^1H NMR (CD_3COCD_3) δ: 6.34 (1H, d, *J* = 15.9 Hz), 6.89 (2H, d, *J* = 8.6 Hz), 7.54 (2H, d, *J* = 8.6 Hz), 7.62 (1H, d, *J* = 15.9 Hz); ^{13}C NMR (CD_3COCD_3) δ: 115.7 (d), 116.8 (d), 127.0 (s), 131.0 (d), 145.8 (d), 160.6 (s), 168.7 (s).

Seseline (10)

Colorless solid; mp 118-120 °C; IR ν_{max} cm^{-1}: 1720, 1627, 1597; EIMS *m/z* (rel. int.) (%) 228 (M^+, 45), 213 (100), 185 (31); ^1H NMR ($CDCl_3$) δ: 1.43 (6H, s), 5.68 (1H, d, *J* = 10.2 Hz), 6.18 (1H, d, *J* = 9.5 Hz), 6.67 (1H, d, *J* = 8.5 Hz), 6.83 (1H, d, *J* = 10.2 Hz), 7.16 (1H, d, *J* = 8.5 Hz), 7.56 (1H, d, *J* = 9.5 Hz).

Xanthyletin (11)

Colorless solid; mp 128-130 °C; EIMS *m/z* (rel. int.) (%) 228 (M^+, 25), 213 (100), 185 (25); ^1H NMR ($CDCl_3$) δ: 1.43 (6H, s), 5.66 (1H, d, *J* = 10.0 Hz), 6.19 (1H, d, *J* = 9.6 Hz), 6.31 (1H, d, *J* = 10.0 Hz), 6.69 (1H, s), 7.02 (1H, s), 7.55 (1H, d, *J* = 9.6 Hz); ^{13}C NMR ($CDCl_3$) δ: 104.2 (q), 112.6 (d), 112.8, 120.7, 124.7, 131.1,143.2(s), 155.3 (d), 156.7 (s), 161.1 (s), 173.7 (s).

Psoralene (12)

Colorless solid; mp 163-164 °C; IR ν_{max} cm^{-1}: 1702, 1620, 1581, 1498; EIMS *m/z* (rel. int.) (%) 186 (M^+, 25), 213 (100), 185 (25); ^1H NMR ($CDCl_3$) δ: 6.35 (1H, d, *J* = 9.6 Hz), 6.81 (1H, dd, *J* = 2.2, 0.8 Hz), 7.44 (1H, br s), 7.66 (1H, s), 7.67 (1H, d, *J* = 2.2 Hz), 7.78 (1H, d, *J* = 9.6 Hz); ^{13}C NMR ($CDCl_3$) δ: 99.8 (d), 106.3 (d), 114.6 (d), 115.4 (s), 119.8 (d),

124.8 (s), 144.0 (d), 146.9 (d), 152.0 (s), 156.3 (s), 161.0 (s).

7,8-(2,2-Dimethylpyrano)-6-prenyl-5,3′,4′-trihydroxy-flavone acetate (13a)

Yellow solid; mp 160-162 °C; IR ν_{max} cm^{-1}: 1760, 1648, 1636, 1592, 1500, 1193; UV λ_{max}^{MeOH} nm (log ε): 230 (4.43), 274 (4.25), 330 (4.15); EIMS *m/z* (rel. int.) (%) 546 (5), 531 (1), 504 (100), 489 (90), 461 (57), 449 (83); HR-EIMS *m/z* 546.1900 (M^+ Cacd for $C_{31}H_{30}O_9$, 546.1890); ^1H and ^{13}C-NMR: see Table 1.

6,7-(2,2-Dimethylpyrano)-8-prenyl-5,3′,4′-trihydroxy-flavone acetate (14a)

Yellow solid; mp 144-145 °C; IR ν_{max} cm^{-1}: 1762, 1648, 1633, 1592, 1501, 1196; UV λ_{max}^{MeOH} nm (log ε): 227 (4.33), 276 (4.35), 328 (4.26); EIMS *m/z* (rel. int.) (%) 546 (12), 531 (100), 504 (27), 489 (74), 461 (51), 449 (69); HR-EIMS *m/z* 546.1903 (M^+ Cacd for $C_{31}H_{30}O_9$, 546.1890); ^1H-NMR: see Table 1.

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REFERENCES

1. Huang, T. C., Ed. *Flora of Taiwan*; National Science Council of the Republic of China: Taipei, 1996; Vol. 2, p 154.
2. Chiu, N. Y.; Chang, K. H. *The Illustrated Medicinal Plants of Taiwan*; SMC Publishing Inc.: Taipei, 1992; Vol. 3, p 40.
3. Lee, T. H.; Kuo, Y. C.; Wang, G. J.; Kuo, Y. H.; Chang, C. I.; Lu, C. C.; Lee, C. K. *J. Nat. Prod*. **2002**, *65*, 1497.
4. Lin, Y. L.; Chen, Y. L.; Kuo, Y. H. *Chem. Pharm. Bull.* **1991**, *39*, 3132.
5. Chiang, Y. M.; Liu, H. K.; Lo, J. M.; Chien, S. C.; Chan, Y. F.; Lee, T. H.; Su, J. K.; Kuo, Y. H. *J. Chin. Chem. Soc*. **2003**, *50*, 161.
6. Yoshiyasu, F.; Yoshinori, N.; Geng, P. W.; Wang, R.; Junko, S.; Bao, J.; Kazuyuki, N. *Planta Med*. **1988**, *54*, 34.
7. Kimura, Y.; Yasukawa, K.; Takido, M.; Akihisa, T.; Tamur, T. *Biol. Pharm. Bull*. **1995**, *18*, 1617.
8. Kuo, Y. H.; Yeh, M. H. *J. Chin. Chem. Soc*. **1997**, *44*, 379.
9. Chen, C. Y.; Chang, F. R.; Teng, C. M.; Wu, Y. C. *J. Chin. Chem. Soc*. **1999**, *46*, 77.
10. Ito, J.; Chang, F. R.; Wang, H, K.; Park, Y. K.; Ikegaki, M.; Kilgore, N.; Lee, K. H. *J. Nat. Prod*. **2001**, *64*, 1278.
11. Natsume, H.; Seto, H.; Otake, N. *Agric. Biol. Chem.* **1982**, *46*, 2101.
12. Lee, C. K.; Lee, P. H.; Kuo, Y. H. *J. Chin. Chem. Soc*. **2001**, *48*, 1053.
13. Teresa, J. D. P.; Moran, J. R.; Hernandez, J. M.; Grande, M. *Phytochemistry* **1985**, *24*, 1779.
14. Reisch, J.; Voerste, A. A. W. *J. Chem. Soc. Perkin Tra*ns. *I* **1994**, 3251.
15. Mali, R. S.; Joshi, P. P.; Sandhu, P. K.; Manekar-Tilve, A. *J. Chem. Soc. Perkin Trans. I* **2002**, 371.
16. Ngadjui, B. T.; Dongo, E.; Happi, E. N.; Bezabih, M.-T.; Abegaz, B. M. *Phytochemistry* **1998**, *48*, 733.